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COURSE IN

Manual Training

FOR GRAMMAR SCHOOLS.

W. W. MURRAY.

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UNITED STATES OF AMERICA.

HANDBOOK FOR TEACHERS.

A COURSE IN

MANUAL TRAINING

FOR

GRAMMAR SCHOOLS.

WITH ILLUSTRATIONS

BY

W. W. MURRAY.

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DESCRIPTION OF THE DESK TOP.

The desk-top was designed to meet the needs of grammar and private schools. It can be clamped to an ordinary school desk, or a shelf, and be released by a single turn of a thumb-screw.

ADJUSTING DESK TOP.

The desk-top consists of a board sixteen inches wide and twenty-four inches long, with a recess at the back, which is fitted with blocks and racks of various forms for holding the tools in their proper places. It is provided with a stop, which is used for holding the wood while planing. This stop, when not in use, can be dropped down flush with the surface, and the top may then be used as a drawing board.

The right hand end is fitted with a shooting-board

—a device for holding pieces of wood while the edges are being planed—this is provided with an attachment which prevents the tipping of the plane, thereby insuring true work.

At the right hand, and attached to the under side, is a shallow drawer, this is intended to hold the drawing instruments, sandpaper-block, sandpaper and nails. A T-square is held in place—on the underside—by means of rabbeted cleats and a spring.

AT WORK AT DESK TOP.

The following is a list of the tools:—Measuring rule, knife, plane, chisel, try-square, marking-gauge, hammer, nail-set, brad-awl, gimlet, pliers, clamp, bench-hook, compasses, triangles, T-square, thumb-tacks and sandpaper-block.

It is not necessary to provide a saw for each desk-top. A table or shelf arranged with three common mitre boxes and three saws will answer for a large class.

The following tools will be required for occasional use:

3—10 inch back saws.
1—18 " panel saw (11 points to the inch).
3—2½ " screw-drivers.
3—¼ " handled auger bits.
1—6 " 2nd cut flat file with handle.
1 Washita oil stone, mounted.
1 Small oil can.
3 Mitre boxes 2⅝ inches wide inside by 2½ inches deep.

MODELS FOR DESK TOP COURSE.

INTRODUCTION.

This hand-book is not intended as a manual for self-instruction, it is simply an arrangement of facts and suggestions relating to the tools and exercises involved in this series of models, to supplement notes taken by the pupil-teacher, which, it is hoped, may be of some assistance to the teacher in her efforts to encourage habits of industry and observation.

To the teacher who aims at proficiency, the knowledge of the work, the right use of tools, and acquaintance with the materials used is indispensable, and the only way to obtain this knowledge is by practical personal experience under an instructor. It cannot be acquired from books.

The course of exercises described in this hand-book is adapted to pupils during the last two or three years in the grammar schools. Courses, which will involve the use of fewer tools, can be arranged to suit the physical and mental capacity of children of the lower grades.

Children love to construct, and this points to a practical means of conveying instruction. But work for children must be of such a nature as will lead them to feel that it is *real work*, not a pretense at it. The course should be a series of useful articles, having a distinct educational value.

In planning this course the aim has been to design such models as would be of value from the boy's

point of view; to make each model an article of use; to give practical applications of a few geometrical problems to actual work, and to afford the teacher a means of translating many perplexing problems in arithmetic and plane geometry.

In the hands of a conscientious teacher, the work will extend further than the making of models; intellectual and moral results will be considered as important as mechanical skill.

Drawing, in order to interest the boy, must show some tangible results, therefore, the teacher should take advantage of every opportunity to show the value of "something" to define the form and proportions of the objects to be made. All work should be done from drawings.

The hammer and pliers used in the desk-top work were selected with a view to introducing light metal work.

NOTES AND SUGGESTIONS.

Lumber:—When ordering lumber, write dimensions thus: 12 pieces of dry white pine ½ in. by 2½ ins. by 15½ ins. Specify quality, when clear lumber is wanted, as follows: free from knots, shakes or sap. When ordering lumber for the models, have the wood cut $\frac{1}{16}$ inch wider than the width as given under the head of rough stock, this will allow for planing.

Nails:—Nails with large flat heads are known as *common nails.* Nails used for fine work have small heads and are called *finishing nails.*

When ordering nails, give length, number of wire and state whether common or finishing nails are wanted. See pages 69 and 71.

Example.—2 lbs. of ¾ inch finishing nails No. 18.

Screws:—When ordering screws, give length of screw and number of wire.

Example.—2 doz. ⅝ inch screws No. 6.

Screws vary in size from ¼ inch No. 0 to 6 inch No. 30. See page 67.

The term *number* as applied to screws and wire nails refers to the *wire gauge* or the diameter of the body of the screw or nail just below the head.

Sandpaper:—Sandpaper is sold by the sheet or quire. No. 1 is the grade used in this course. For further information relating to sandpaper see page 62.

Glue:—Use the liquid glue. Two or three small cans will answer for a large class.

Emery Cloth:—To remove rust from the tools use No. 00 emery cloth and machine oil.

For the drawings and for marking lines on the wood, use a pencil of medium grade. It must be *kept sharp.* Soft pencils with blunt points should not be tolerated.

Pupils should measure their wood to test dimensions before proceeding to work it up.

It is not safe to test the keenness of a sharpened tool by running the finger lightly across the edge. If the edge appears white and rounded it may be regarded as dull; if the edge is invisible when held up against the light, it is sharp.

The sharpening can be done by a practical man, at small cost.

Tact must be exercised in deciding the degree of accuracy to be expected from each individual pupil. Very often what a boy of ten years can accomplish may be difficult for one of twelve. Be guided by the mental and physical powers, rather than the age.

Do not insist on the repetition of the same model more than three times at the outside. The principle involved may be given in another form.

Guard yourself against giving any more help than is absolutely necessary.

Use technical terms. Do not say "thing" for marking-gauge nor "business" when you mean try-square.

Insist on cleanliness and neatness and that each tool, when not in use, be kept in its proper place.

If "chip-carving" is introduced it should be permitted only on such articles as have been constructed by the pupil.

When the pupil's work has been "accepted" by the teacher, a neat label should be pasted on, and on this label should be stated the number of the model and its name; the name and age of the pupil.

The articles should be regarded as the property of the makers.

MODEL I.

A Flower Pot Stand.

The first exercise involves the use of more tools than many of the other models, but it has been placed first in the series not only because it is the easiest, but for the reason that there are certain principles which lie at the foundation of manual training that should be taught at the beginning.

It gives the typical use of the most important tools, and it shows the pupil the significance of accuracy of measurement.

The drawing for this model and model No. 2 may be prepared for the pupil, or by him, according to the discretion of the teacher.

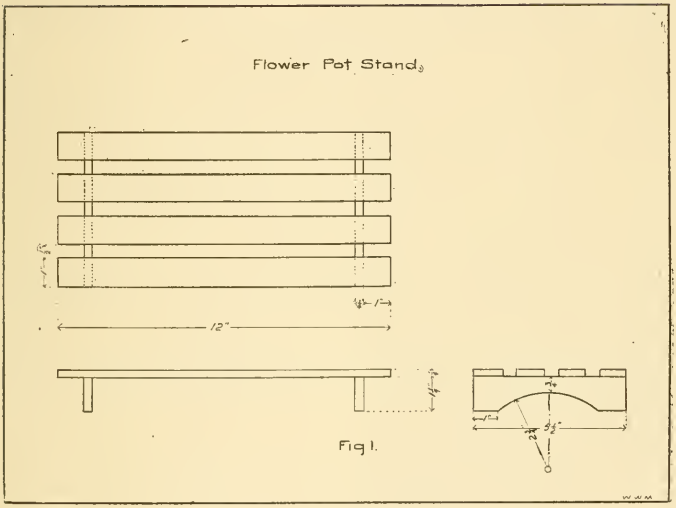
The teacher can simplify the work and avoid confusion, by giving the pupil the material necessary for the two standards only, which should be completed before giving out the pieces for the slats.

Tools used:—Rule, plane, try-square, compasses, knife, file, saw, hammer, nail set, and centering clamp.*

Rough stock:—4 pcs. of pine ¼ in. by 1 in. by 12½ ins.
" " —2 " " ¼ in. by 1¼ in. by 6 ins.

Nails:—16 nails, ½ in. No. 20.

* The centering clamp is a device for holding the standard at right angles to a line from which the curved line is struck.


Flower Pot Stand.
12"
Fig 1.

MODEL II.

A Form.

This is a *form* upon which the strips for the curved cross-pieces in model No. 3 are bent—after soaking in water—and secured until dry.

To find the center from which to describe the curved lines, follow the method shown in Fig. 2. Draw the line H K, Fig. 2, to equal line A B, Fig. 3. Bisect H K in L. Let L M equal C D, Fig. 3. Bisect M H and M K, and produce the bisecting lines until they meet in P. With P as a center and P M the radius, draw the curve H M K.

The radius for the concave edge of the *form* will be the distance from G to D, Fig. 3, less than the radius P M, Fig. 2.

In order to make this problem interesting and clearly understood, the teacher might have the pupil make any three points—not in a straight line—on the blackboard, then show how to locate the center from which to draw a circle that will pass through the three given points.

This problem should be worked out on heavy paper or card-board. The figure may be cut out and used as a pattern for drawing the lines on the piece of wood intended for the pupil's model.

Tools used:—Knife and file.

Rough stock:—1 piece of pine ¼ in. by 2½ in. by 12 in.

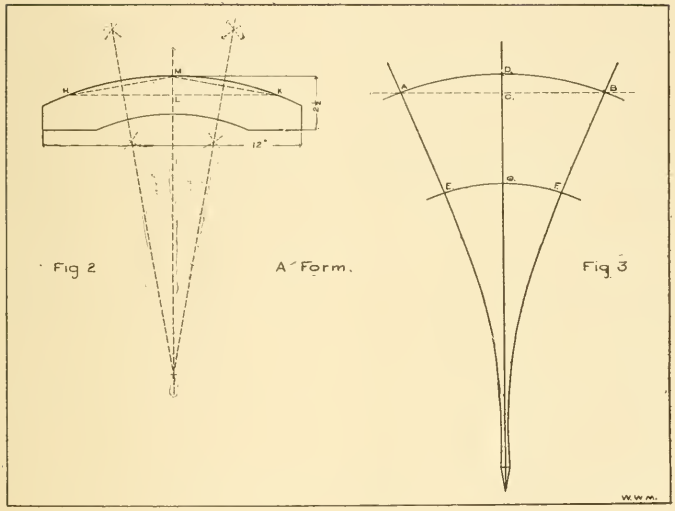


Fig 2 A Form. Fig 3

MODEL III.

Frame for a Vine.

This frame is made of thin basswood. The uprights are three narrow pieces fastened together at the base with fine copper wire.

The method of joining the parts at the junction of the uprights and cross-piece is termed halving, or half-lap joint, as shown in isometric view, Fig. 4.

Inasmuch as this is the pupil's first lesson in drawing, he need not attempt to make a drawing of the completed piece, but merely draw two views of the upright as in Fig. 5. After the drawing has been completed, the pupil should be given the material necessary for *the part drawn*. When the upright pieces are cut out, fastened together and the lower end pointed—as shown in the drawing—the pupil may make the drawing for the cross-pieces as in Figs. 6 and 7. The pieces should be marked out, cut to the proper length and ends notched, but the joints must not be cut until the pieces are dry and have been removed from the form.

Tools used:—Try-square, knife and pliers.

Rough stock:—3 pieces of basswood ⅛ in. by ⅜ in. by 20 in.
" " —1 piece of basswood ⅛ in. by ⅜ in. by 12 in.
" " —1 piece of basswood ⅛ in. by ⅜ in. by 7 in.

NOTE.—For a description of the method of bending wood, see page 30.

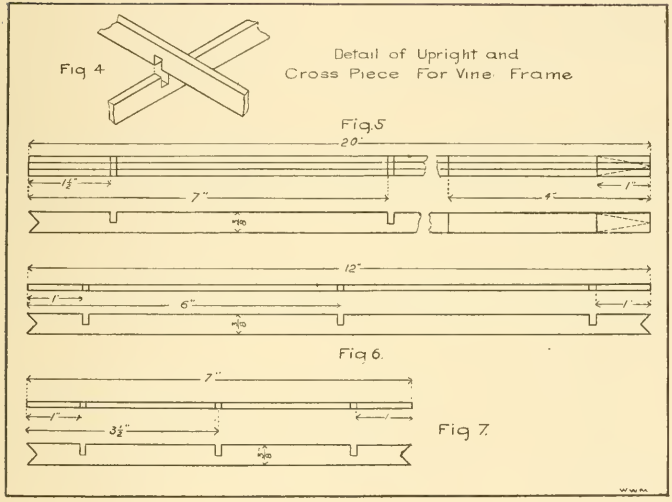


Fig 4.
Detail of Upright and
Cross Piece For Vine Frame
Fig 5
20"
1½"
7"
4"
1"
12"
1"
6"
Fig 6.
7"
1"
3½"
Fig 7.

MODEL IV.

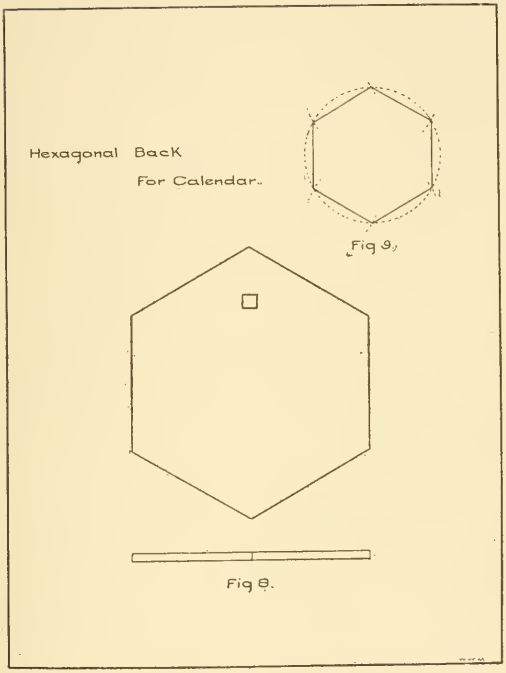
Hexagonal Back for Calendar.

The hexagon is made of thin basswood and is used as a back for a small calendar. The pupil should make a drawing of this model, showing two views as in Fig. 8. To construct the hexagon, draw a circle 5 in. in diameter, set off the radius around it and join the points, as in Fig. 9. The radius of a circle goes around the circumference as a chord six times.

The calendar is fastened to the hexagon with the aid of narrow ribbon.

Tools used:—Compasses, knife, gimlet or ¼ in. bit, and plane, which is used to smooth the edges.

Rough stock:—1 piece of basswood ⅛ in. by 5⅛ in. by 5⅛ in.


Hexagonal Back
For Calendar.
Fig 9.
Fig 8.

MODEL V.

A Bandilore.

The origin of the bandilore is unknown, though some say it was invented to amuse an East Indian princess. It was brought in 1790 from Bengal to England, where it became quite fashionable under the name of Quiz. Moore says that his earliest verses were composed on the use of this toy. The bandilore consists of two discs and a hub, which are joined at the center, and having a string wound between the discs. The player takes one end of the string and allows the bandilore to fall, revolving as the string unwinds. Just before it reaches the end of the string he gives it a quick jerk upwards, and the spin it has acquired will then wind the string in the opposite direction and cause the toy to ascend. The discs are made of thin basswood and the grooved hub between them is of pine.

As the circles of this exercise are marked from a pattern which leaves nothing to indicate the centres of discs, it is necessary, before the model can be completed, to lay this aside and take up the next exercise. The discs are secured to the hub with the aid of glue and nails.

The pupil should make a drawing showing a side view and section, as in Fig. 10.

Tools used:—Knife, file, and hammer.

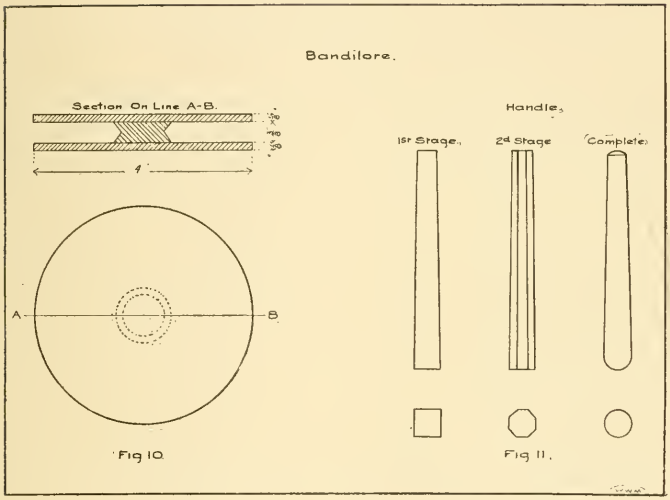
Rough stock:—2 pcs. of basswood ⅛ in. by 4 in. by 4 in.
" " —1 piece of pine ⅜ in. thick by 1 in. by 1 in.

Nails:—4, ½ inch nails, No. 20.

The Handle for Bandilore. Make drawing of handle, as in Fig. 11, which shows the different stages in the formation of a round.

Tools used:—Knife, file, and brad-awl.

Rough stock:—1 pce. of poplar ½ in. by ½ in. by 4 ins.


Bandilore.
Section On Line A-B.
4"
A
B
Handle.
1st Stage.
2d Stage
Complete
Fig 10.
Fig 11.

MODEL VI.

A Centering Gauge.

The centering-gauge is constructed for the purpose of locating the centers of discs in Model No. 5.

The drawing should be made full size, and show two views, as in Fig. 12. The method of constructing the angle in the stock of the centering-gauge is shown in Fig. 13.

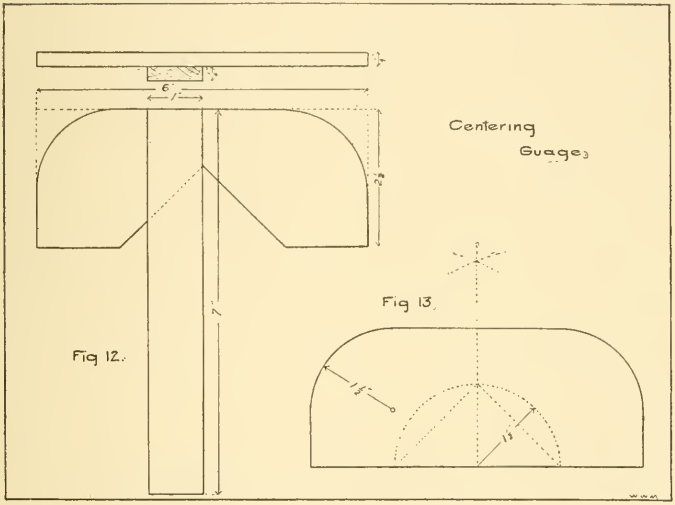
The blade is secured to the stock by gluing and nailing with round head brass nails.

Tools used.—Plane, try-square, compasses, knife, file, saw, awl, and hammer.

Rough stock:—1 piece ¼ in. by 2½ ins. by 6 ins.
" " —1 piece ¼ in. by 1 in. by 7 ins., pine.

Nails:—½ in. No. 18, round head brass nails.*

*Escutcheon pins.


6"
1"
2½"
7"
Centering
Guages
Fig 12.
Fig 13.
1½"
1½"

MODEL VII.

A Plumb Rule.

The plumb-rule is a narrow board with parallel edges having a straight line drawn through the middle, and a string carrying a metal weight attached at the upper end of the line. It is used by bricklayers, carpenters, etc., for determining a vertical. The metal weight attached to the end of a plumb-line is called a plumb-bob.

Level is the term applied to surfaces that are parallel to that of still water or perpendicular to the direction of the plumb-line.

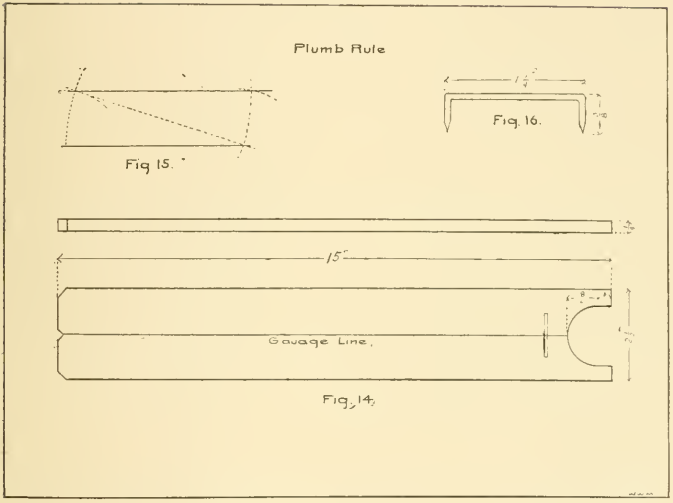
The simplest form of a leveling instrument is that of a straight-edge, and plumb-rule united in the form of a letter L; they must be exactly perpendicular to each other, then, when the plumb-rule is vertical the other ruler is horizontal or level.

The spirit level shows the exact level by means of a bubble of air.

The plumb-rule is a very important tool, and great care should be taken to make it perfectly parallel. The plumb-bob is of lead, and the guard near the base and in front of the cord is of brass wire.

Make the drawing half or three-quarter size, showing two views, as in Fig. 14. In drawing the parallel lines, which represent the edges of the plumb-rule, use compasses and ruler, and follow the method shown in Fig. 15.

Fig. 16 shows the dimensions and shape of the wire guard.


Plumb Rule
Fig 15.
Fig. 16.
15"
Gauge Line.
Fig. 14.

Use heavy thread for the line. The *bob* should be of lead and weigh about an ounce.

Tools used:—Plane, marking-gauge, try-square, compasses, knife, file and pliers.

Rough stock:—1 piece of pine ½ in. by 2½ ins. by 15 ins.

Wire:—One piece of No. 19 brass spring wire 2 ins. long.

MODEL VIII.

A Bench Hook.

The bench-hook is a tool similar to that used in the desk-top outfit. In the drawing for this model the pupil should be taught to construct the rectangle with the compasses and ruler as in Fig. 18. Make the drawing half or three quarter size, as in Fig. 17.

Tools used:—Plane, saw, gimlet, screw-driver and chisel.

Rough stock:—1 piece of pine ⅜ in. by 4 ins. by 8½ ins.

" " —1 piece of pine ⅜ in. by 1⅛ ins. by 8¼ ins.

Screws:—4 screws ⅝ in., No. 6.

Bench Hook.

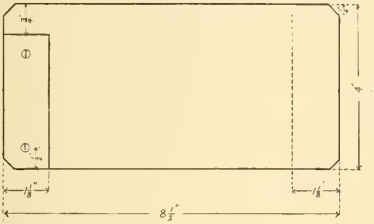


Fig 18.

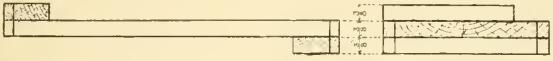


Fig 17.

MODEL IX.

A Window Screen.

The drawing of this model, which should be full size, need only show two views as in Fig. 19. The upright pieces in this frame, as in sash, doors, blinds, and panel work are called *stiles*, the horizontal pieces are called *rails*. The method of joining the stiles and rails of this model, by cutting half the depth of the wood away from each, is termed half-lapping, or the *half-lap* joint. See isometric view of joint in Fig. 20.

The manner of joining the stiles and rails of sash, doors, and blinds is known as the *mortise* and *tenon* joint.

In marking out the lines for the joints *gauge from the face side.*

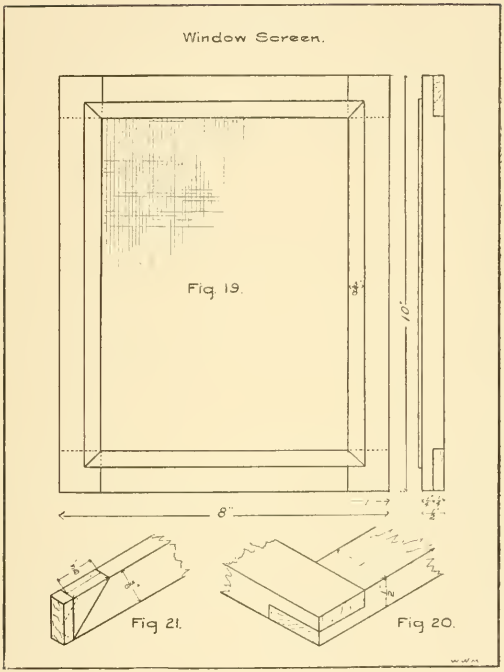
The face sides should be "in and up"—*i. e.*, next to the wire screen.

The joints are screwed from the back with ⅜ inch screws, No. 5.

Before inserting the screws the frame is placed in a small cleated board, and the joints drawn together by means of wedges.

The narrow band that covers the edges of the wire screen is mitred at the corners and fastened to the frame with ½ inch nails. Fig. 21 is an isometric view of a section of the band, showing the method of marking out lines for the mitre.

Tools used:—Plane, try-square, gauge, saw, chisel, gimlet, screw-driver, knife and hammer.


Window Screen.
Fig. 19.
10"
8"
Fig 21.
Fig 20.

Rough stock:—2 pieces of pine, ½ in. by 1 in. by 11 ins.
" " 2 pieces of pine, ½ in. by 1 in. by 9 ins.
" " 2 pieces of basswood, ⅛ in. by ⅜ in. by 10 ins.
" " 2 pieces of basswood, ⅛ in. by ⅜ in. by 8 ins.
Screws:—12 screws ⅜ inch, No. 5.
Nails:—14 nails ½ inch, No. 20.
Wire screen.—1 piece 6⅝ ins. by 8⅝ ins.

MODEL X.

A Key Board.

This model is made of thin basswood and round head brass nails.

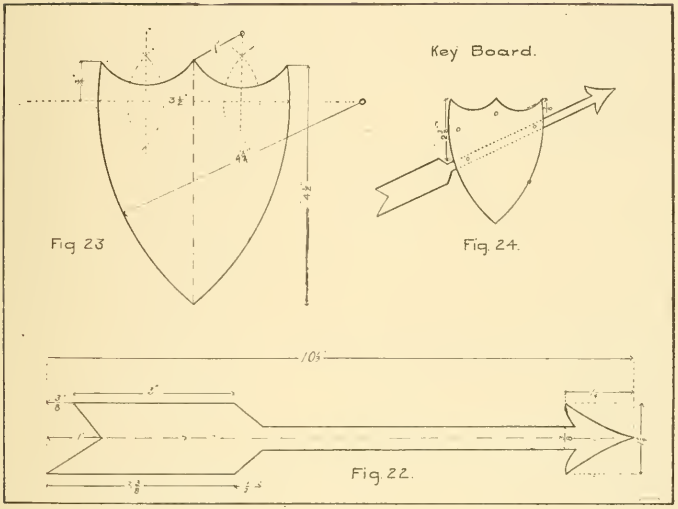
The drawing may be made of the separate parts as in Figs. 22 and 23, or in the case of the more apt pupils a drawing may be made of the completed piece as in Fig. 24.

The curved lines of the arrow head are drawn freehand. After the arrow has been completed, a full-sized drawing of the shield should be made on a separate piece of paper, then this may be cut out and used as a pattern to mark out lines on the wood.

The arrow and shield are fastened together with glue and round head brass nails.

Tools used:—Try-square, compasses, knife, file and hammer.

Rough stock:—1 piece of basswood ⅛ in. by 3½ in. by 4½ inches.
" " —1 piece of basswood ⅛ in. by 1¼ ins. by 10½ ins.
Brass Nails:—2 round head ½ in. long, No. 18.
" " —4 " " ⅜ in. long, No. 18.


Key Board.
Fig. 23
Fig. 24.
Fig. 22.

MODEL XI.

A Nail Box.

The drawing of this model, which may be to scale ½ or ¾, should show three views. In nailing the sides and ends together use ¾ inch nails, and for the bottom use ½ in. nails. The handle is of ash, and is secured to its place with five round head brass nails in each end. Before attempting to bend the handle to its place it should be placed in water for a few minutes, or until it seems quite pliable.

Tools used:—Plane, try-square, saw, brad-awl, hammer and nail set.

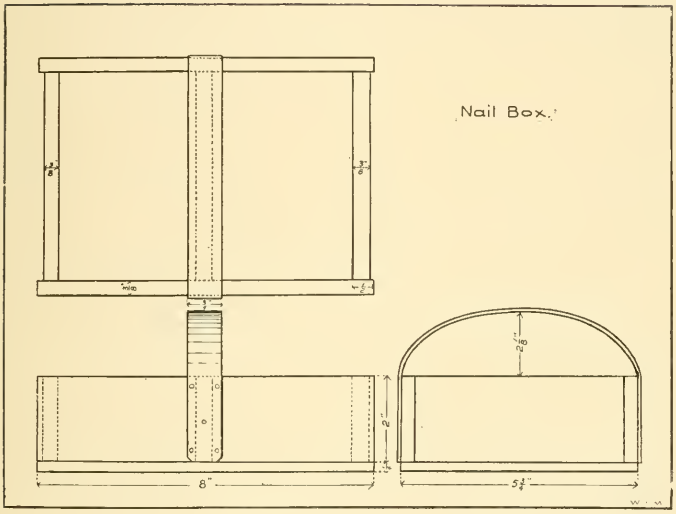
Rough stock:—2 pieces of pine, ⅜ in. by 2 ins. by 9 ins.
" " —3 pieces of pine ⅜ in. by 2 ins. by 5½ ins.
" " —1 piece of pine ¼ in. by 5¾ ins. by 8½ ins.
" " —1 piece of ash, ⅛ in. by ¾ in. by 12 ins.

Nails:—½ in. No. 20, and ¾ in. No. 18.

**Brass Nails:*—10 round head brass nails, ⅜ in. long, No. 18.

* Escutcheon pins.

Large pieces of wood are boiled or steamed before bending. The method of bending wood depends upon the size of the piece and the kind of wood, hard wood requiring longer boiling or steaming. A piece of ash, say 2 ins. by 4 ins. in cross section, would require about six hours steaming with a low pressure of moist or wet steam, but it would not suffer damage if steamed for a day. If the wood is steamed too much it loses its elasticity and will pucker on the inside surface of the bend when in the form or bend-


Nail Box.
8"
5¾"

ing block. Pieces not over half an inch thick may be bent after steaming them half an hour.

One method of bending wood, after steaming, is to fasten on the outside or convex side of the piece, an iron strap that will prevent it from stretching. The piece with the strap on the outside is laid on the form or forming piece; this is then secured to an apparatus called a winch. The winch is provided with a rope whose ends have two hooks which are engaged in the eyes of the strap, and by operating the winch the piece is bent to shape.

MODEL XII.

Winding Strips.

The drawing should show two views as in Fig. 25.

The winding strips are two parallel pieces with straight edges, used for testing the accuracy of plane surfaces.

Winding is a term applied by joiners to a surface which is twisted so that all its parts do not lie in the same plane. To test whether the surface is really true, the winding strips are laid, one on each end of the piece of work. If the surface is true, the upper edges of the rulers will be found to be in the same plane. Fig. 26 shows the application of the winding strips.

Tools used:—Plane, gauge, and ¼ inch bit.

Rough stock:—1 piece of black-walnut ⅜ in. by 1¼ ins. by 12 ins.

" " —1 piece of cherry ⅜ in. by 1¼ ins. by 12 ins.

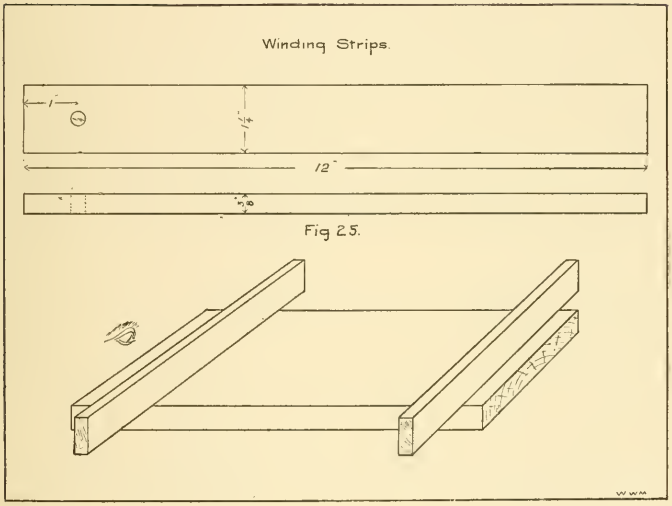


Fig 25.

MODEL XIII.

Wall Bracket.

Designs for wall brackets are numerous. Some are merely pieces of wood, cut as a shelf to fit a corner with or without more support than nails driven into the wall, or they may be made very ornamental and tasteful, according to one's skill and patience.

This simple form is introduced to show the principles on which they are made. The drawing should show three views: top view, front view and side view as shown in Figs. 27, 28 and 29. The outline of shelf support may be drawn freehand, see *a* Fig. 29.

Tools used:—Plane, try-square, compasses, knife, file, ¼ inch bit, hammer and nail-set.

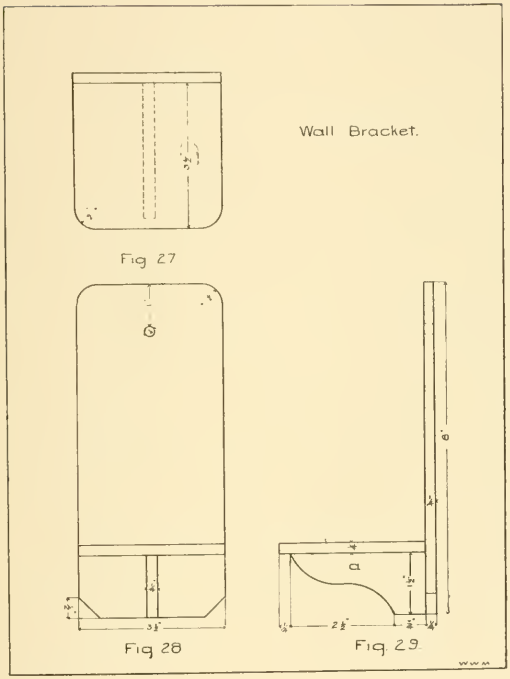
Rough stock:—1 piece of pine ¼ in. by 3½ ins. by 8 ins.

" " —1 piece of pine ¼ in. by 3½ ins. by 3½ ins.

" " —1 piece of pine ¼ in. by 1½ ins. by 3¼ ins.

Nails:—3 nails ¾ in. No. 18—through back into shelf.

" —1 nail ½ in. No. 20—through shelf into support.


Wall Bracket.
Fig 27
Fig 28
Fig 29.

MODEL XIV.

A Triangle.

This exercise is a 30° and 60° triangle. Used for drawing purposes. Two views of this model are shown in Fig. 30. To construct the triangle the pupil should follow the method shown in Fig. 31.

Draw line AC, Fig. 31, to equal GH, Fig. 30. Bisect AC in B. With B as a centre and radius AB, draw arc CD. With centre C and same radius cut this arc in D. Draw AD, DAC=30°.

To draw a perpendicular to line AC from point C. With BC as a radius and D as a centre draw an arc over C, and draw a line through BD, producing it to meet this arc in E. Join CE, and CE is the perpendicular required.

Tools used:—Compasses, knife, plane and ¼ in. bit.

Rough stock:—1 piece of maple ⅛ in. by 4 ins. by 7 ins.

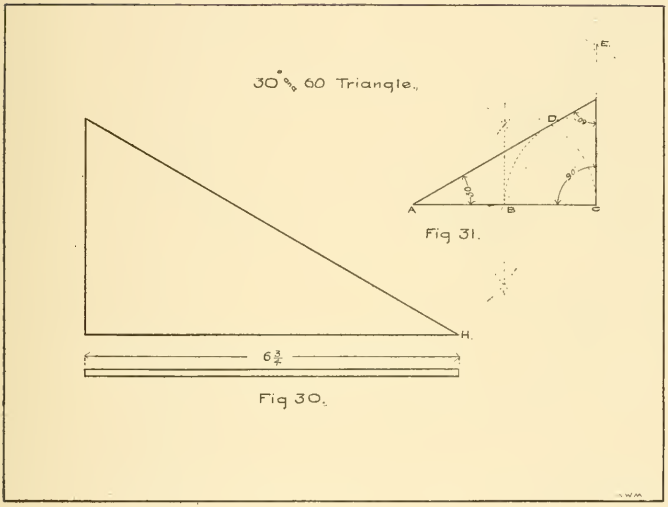


Fig 31.

Fig 30.

MODEL XV.

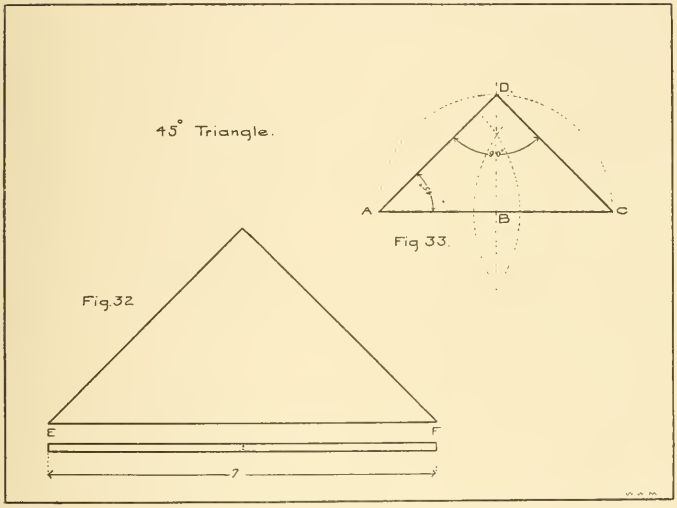
A 45° Triangle.

The 45° triangle is made of the same material as model No. 14. Used for drawing purposes. To construct this triangle, draw line AC, Fig. 33, to equal EF, Fig. 32. Bisect AC in B. With B as a centre and AB as a radius describe a semi-circle. Connect DA and DC, DAC=45°.

Tools used:—Compasses, knife, plane and bit.

Rough stock:—1 piece of maple ⅛ in. by 4 ins. by 7 ins.

In ordering material for the triangles it will be well to furnish a pattern, cut to the right shape, but about ⅛ inch wider and longer than the finished model.


45° Triangle.
D
90°
45°
A
B
C
Fig 33.
Fig. 32
E
F
7

MODEL XVI.

A T-Square.

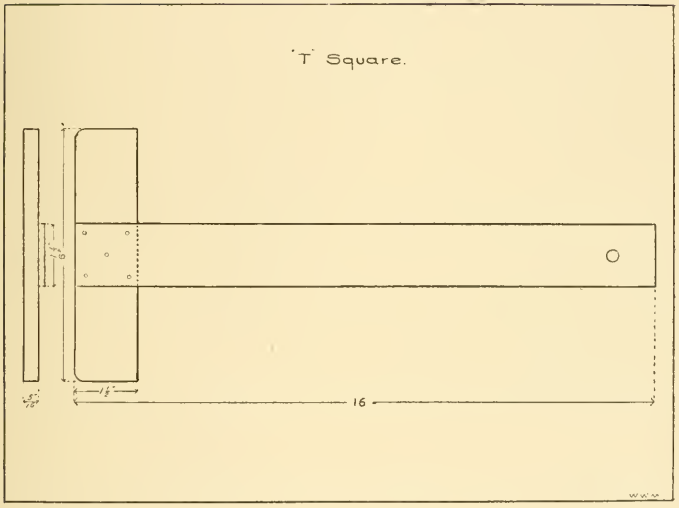
The T-square is constructed of the same material as the triangles. The stock is ⅜ in. by 1½ ins. by 6 ins. and the blade is ⅛ in. by 1½ ins. by 16 ins. The blade is secured to the stock with the aid of glue and round head brass nails.

Tools used:—Plane, try-square, gauge, saw, chisel, file, ¼ in. bit, and hammer.

Rough stock:—1 piece of maple ⅛ in. by 1½ ins. by 16½ ins.

" " —1 piece of maple ⅜ in. by 1½ ins. by 6½ ins.

Nails:—5, ⅜ in. brass nails, No. 18.


T Square.
1½
16

MODEL XVII.

Fancy Box.

This model is made of thin basswood. The lines are drawn freehand. The pupil should make a drawing showing a view of the side of the box as in Fig. 34, and a section showing position of the bottom as in Fig. 35. An isometric view is shown in Fig. 36.

The bottom of the box is made of the same material as the sides, and is fastened to its place with the aid of four narrow strips of paper and glue. The corners are held together with "baby" ribbon.

Tools used:—Knife and gimlet.

Rough stock:—4 pieces of basswood $\frac{1}{8}$ in. by 4 ins. by $4\frac{1}{8}$ ins.

" " —1 piece of basswood $\frac{1}{8}$ in. by $3\frac{1}{8}$ ins. by $3\frac{1}{8}$ ins.

Ribbon:—$2\frac{2}{3}$ yards.

Fancy Box

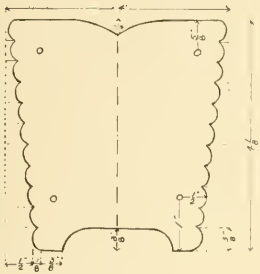


Fig 34.

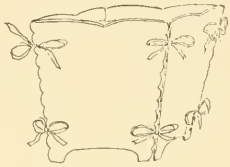


Fig. 36.

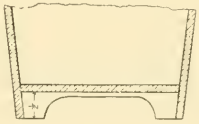


Fig 35

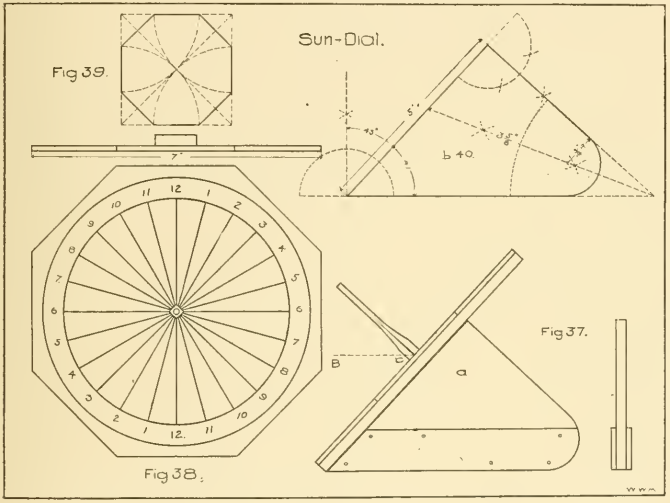
MODEL XVIII.

A Sun-Dial.

The dial consists of a piece of thin basswood cut out in the form of an octagon; this is stiffened by means of a cleat fastened to the back. The dial is held to the proper angle by the triangular piece *a*, Fig. 37. The circumference of the circle on the face of the dial is divided into twenty-four equal parts, numbered from one to twelve, twice over, as in Fig. 38. In the centre is a fixed straight post called a style, which must be perpendicular to the face of the dial. The accuracy of the dial depends on this, and on its being *placed so that the style points in the same direction as the earth's axis.* This may be brought about by fixing the dial so that the angle between the horizontal line BC, Fig. 37, and the style just equals the latitude of the place. This can be done by finding the latitude on a map, then deducting this from the number of degrees in a right angle gives the angle for the piece *a*, Fig. 37. The angle may be constructed with the aid of a protractor. The lines for the triangular piece *a*, Fig. 37, should be drawn on the wood as in Fig. 40.

The method of constructing the octagon is shown in Fig. 39.

After the model is finished it may be fixed in position. The base must be horizontal, and the dial placed, with the aid of a compass, *so that the style points due north.*


Sun-Dial.
Fig 39.
7"
5"
45°
b 40.
Fig 38.
Fig 37.
B
a

Another method of finding the proper angle, and fixing the dial in position, is to drill a small hole through the plate, close to the style, and then, on a clear night, the dial is so placed that by looking through this hole the north star is brought into line with the style.

> "With warning hand I mark time's rapid flight
> From life's glad morning to the solemn night;
> Yet, through the dear God's love, I also show
> There's light above me by the shade below."—J. G. W.

Sun-dials are now seldom met with, though in some parts of Europe we may still occasionally see one fixed to the south side of an old church or standing as an ornament in the garden, but at one time were much more common, and before clocks were invented were almost the only means of measuring time with any approach to accuracy. The instrument has been in use from the earliest times. The Hebrews were acquainted with it at least seven centuries before the Christian era. In the book of Isaiah we find mention of the sun-dial, "Behold I will bring again the shadow of the degrees, which is gone down in the sun-dial of Ahaz, ten degrees backward. So the sun returned ten degrees, by which degrees it was gone down"—ISAIAH xxxviii: 8.

In England down as late as the seventeenth century no mathematical treatises were so common as those on dialling. The dial, of course, labors under the disadvantage of not being of any use in cloudy weather or after sunset.

It registers only the hours of sunshine, and hence in very early times it was customary to calculate the hours of night from some prominent star. Arago tells us that the Abbot of Cluny consulted the stars when he wished to know the time for midnight prayers; at other times a monk remained awake, and in order to measure the lapse of time, repeated certain psalms, having learnt by experiment how many he could say in an hour.

There was also a kind of water clock called *Clepsydra* (water-stealer), which was a vase filled with water with a small opening in the bottom through which the water dripped drop by drop into a vessel beneath, which was thus said to steal the water. The side of the vase was divided into spaces by lines, and the height of the water in it marked the time.

Instruments like our hour-glasses were also used, in which the time was measured by the running out of sand.

King Alfred, the Great, is said to have marked time by the gradual burning down of candles colored in rings.

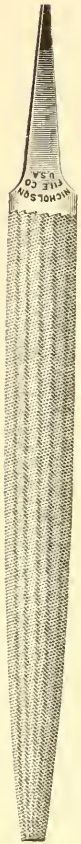
Tools used:—Compasses, knife, plane, try-square, file, brad-awl, gimlet and hammer.

Rough stock:—1 piece of basswood 1/8 in. by 7 ins. by 7 ins.

" " —1 piece of pine 1/4 in. by 5 1/2 ins. by 5 1/8 ins.

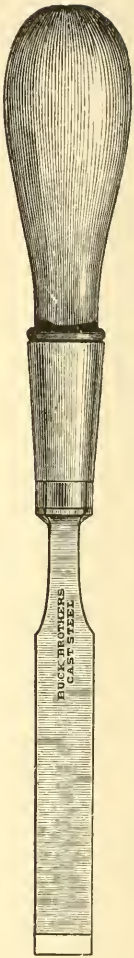
" " —3 pieces of pine 1/4 in. by 1 in. by 7 1/2 ins.

Nails:—1/2 inch, No. 20, and 3/4 inch, No. 18.



HALF-ROUND FILE.

SOCKET FIRMER CHISEL.



TANG FIRMER CHISEL.

DESCRIPTION OF THE TOOLS.

Measuring Rule.

The rule is a straight piece of wood, twelve inches long, and graduated to eighths and sixteenths. It serves as a guide in drawing straight lines, and measuring off short distances.

The English foot (in use in the United States) contains 12 inches and is equal to 30.48 centimeters. It seems to have lengthened since the time of Henry VII. The feet in use in different countries before the introduction of the metric system, varied from 9 to 21 inches.

The standard is kept at Washington and was copied from the English standard which is kept at London.

In teaching pupils the use of the rule in measuring and marking off their work, be careful to impress them, that in any undertaking, preparation is an important factor in arriving at accuracy—to refrain from guessing and all guess work.

Lowell has told us, that—

> "Folks that worked thorough was the folks that thriv,
> But bad work follers ye ez long's ye live.
> Ye can't get rid on't just as sure as sin,
> Its allers askin' to be done agin."

Planes.

The plane is a tool for smoothing, truing and finishing woodwork. The essential parts of a plane are a stock or frame of wood or metal, having a smooth, concave or convex sole or face, and a throat in which is placed a steel cutter called the cutter or bit. Various devices are used to keep the cutter in position in the stock, the most simple being a wedge of wood. Planes are made in a great variety of shapes and sizes, and range in size from 3 to 30 inches in length. Nearly all are distinguished by names having reference to the particular kind of work for which they are designed, as the *smoothing-plane*, *jack-plane*, *fore-plane*, *jointer-plane*, *block-plane* and a great variety of planes for forming mouldings, etc.

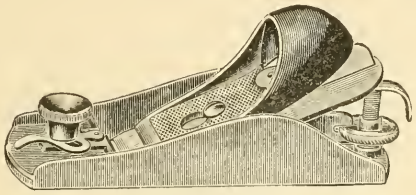
The Japanese planes are small with no handles. The planes are shorter, lighter, and the stock shallower than ours, being generally not more than one inch deep. To plane a piece of wood they lay it on the ground, squat down, hold it fast with their toes, and work the plane by drawing it with both hands toward them.

Some of their tools appear to be mere children's toys; for instance they have a smoothing plane two and one-half inches long, one inch broad, and half an inch thick.

Block Plane.

This tool is used chiefly for planing across the ends of boards, or of blocks (across the grain) and in

fitting close joints. On small work, if the wood is soft and straight grained, the block-plane may be used as a smoothing-plane for planing with the grain.



BLOCK PLANE.

The pitch of the cutter is less than in ordinary bench planes, and the cutter is used with the bevel uppermost at the cutting edge, to further aid in cutting across the grain of the wood. The cutter is clamped in place by means of the lever which is attached to cap. The pressure exerted by this lever is regulated by turning the slotted screw, near lower end of cap.

To release cap and cutter move lever to the right. The lever, when in position to hold the cutter to its place, should be parallel with side of plane.

It sometimes happens in replacing cutter and cap, that difficulty is experienced in bringing the lever back to its proper position. This is usually because the tooth on inner end of lower lever has not found its place in the groove on underside of cutter.

The thickness of shaving is regulated by means of the thumb-screw and lever beneath the upper end

of cutter. Turning the thumb-screw to the left forces the cutter down, turning to the right draws it up.

The long lever, immediately beneath the cutter, is for adjusting the cutter sidewise, to set the cutting edge parallel with the sole or face of plane. The opening in the sole of plane is called the throat. The width of the throat is regulated by aid of the eccentric plate under the brass knob. By moving the eccentric plate to the right or to the left the throat can be closed or opened as coarse or fine work may require. A single turn of the knob will loosen or fasten the plate. For ordinary work the throat should be about $\frac{1}{16}$ of an inch wide. For cross-grained wood, the space should be as small as will permit of free passage for shavings. If throat of plane becomes clogged, take it apart, never attempt to remove chips or shavings by pushing them out.

Try Square.

The try-square consists of a thin blade of steel with parallel edges, fitted and riveted in and at right angles to the stock. The stock is generally a piece of rosewood or cast-iron shorter than the blade. The size of squares are reckoned by the length in inches of the blade.

The most important point in the construction of a square is the right angle between the stock and blade. Try-squares are very frequently ruined by

using them to drive tacks, or brads, and by dropping, which "knocks them out of square."

To test a square let the broad side of the blade rest on the plane surface of a board, and the stock against a perfectly straight edge. Draw a fine line across the board and along the outer edge of the blade. The square is then reversed, the stock is placed as before, and the edge of blade is placed close to the line previously made. Another line is then drawn along the edge of blade as before. If this line is perfectly parallel with that made first, the square is *true*.

The try-square is used for describing right angles, and testing the *truth* of work. The square was regarded in ancient times as the *sign of perfection.*

In giving the application and uses of the square, the teacher might depict the beauty of truth in every relation in life, (1) *at home,* (2) *in school,* (3) *in business. Show how embarrassment and loss are caused by hastiness and carelessness of truth.*

Compasses.

Is an instrument for describing circles, or for measuring figures, distances between two points, etc. Also called dividers.

Knife.

The pocket knife is a very important tool and one of the first to be placed in the hands of a beginner. It is, therefore, important to select one of the best quality, and it should have two blades.

The knife, which requires a stiff edge, must be held when sharpening on an oilstone at an angle of 20° or 25°. Should the blade be laid flat on the stone the edge is made too thin, and consequently the edge will appear brittle or become dull very quickly.

The joints should be oiled occasionally, as they are liable to become rough and hollow, thereby causing the points of the blades to protrude.

File.

A steel instrument for smoothing surfaces, and having raised cutting edges (teeth) made by the indentions of a chisel.

Files are mentioned in I Samuel, xiii : 21, 1093 B. C. "They had a file for the mattocks, and for the coulters, and for the forks, and for the axes, and to sharpen the goads."

Files are graded by *shape*, *size*, and by fineness of cut.

The shape or style of file is distinguished by certain technical names, as, for instance, *flat*, *round*, *half-round*, *three-square*, &c.

The terms *single cut*, *double cut*, and *rasp* have reference to the character of the teeth.

The terms *rough*, *coarse*, *bastard*, *2nd cut* and *smooth* have reference only to the coarseness of the teeth.

The *rough* and *coarse* are adapted to files used upon soft metals, as lead, pewter, &c., and, to some extent, upon wood.

Files having two courses of chisel cuts crossing each other are called *double cut.*

The length of files is always measured exclusively of their tang.

The file selected for the desk top outfit is known as a double cut, half round.

The approximate number of cuts in an inch of file varies from 56, in the 4 inch rough, to 216 cuts in the 4 inch superfine.

The Back Saw.

This saw is used for cutting across the fibres, and only for light, fine work. To stiffen the blade, its upper edge is enclosed in an iron back.

The handle is of apple-wood.

The size of saw teeth is expressed by the number of points — teeth points — contained in an inch.

Cross-Cut Saw.

The cross-cut saw is designed for cutting across the fibres, and in order to prevent pinching or binding, it divides each fibre in two places at once, leaving a path or "kerf" for the blade to run in and the material to fall out through.

If you undertook to divide a board in two crosswise by successive knife-cuts, you would soon find the necessity for having a groove at least as wide as the thickness of the blade; and this could be accomplished only by severing each fibre twice; making

two parallel cuts between which the material was removed to leave the kerf.

Every other tooth of the cross-cut saw is beveled to right and to left so as to help make the right hand or the left hand score. The filing should be so accurate that a needle could be slid along the groove left between or formed by the beveled tooth edges.

It is the outside edge of each tooth that does the cutting.

Rip-Saw.

The rip-saw is used for cutting in the direction of the length of the fibres. The angle of the teeth is more acute than that of the cross-cut saw, and filed straight across, or when filing the file is held at right angles to the blade. The teeth of the rip-saw are like a series of narrow chisels, and if we should attempt to use it as a cross-cut saw to cut across a thin board it would tear and destroy the wood.

History of the Saw.

Saws of the bronze age have been discovered in Germany and Denmark. The metal was cast thin, and probably was notched on the edge by chipping and grinding.

Saws of the stone age were made by setting flakes of flint in wooden handles and securing with mineral pitch. The saw is a very old device, as old as a knife with a ragged edge.

The ancient Egyptian blade was of bronze, at-

tached to the handles by leathern thongs and was single handed. Some of the blades, however, are set into the handles with tangs, like our case-knives.

Japanese saws are shaped like butchers' cleavers. The handle is flattish, as if whittled out of a piece of inch board; the shank of the saw is driven into the handle, and the whole is secured by being wrapped with fine split cane. The metal of the saw is about the substance of our saws, but the teeth are narrower, giving more of them to an inch and much longer. The teeth are pointed toward the handle. When a Japanese wants to rip a plank, he places it across anything which will elevate the end a few inches, then stands on the wood and cuts by seizing the cleaver-looking saw in both hands, and pulling it toward him, working it by short, quick, up-strokes.

Formerly the larger portion of our saws came from Sheffield, England, but Philadelphia, Pittsburg, Cincinnati and other places make them of the best quality and from American steel of American iron.

Making a saw involves the following processes;

1. Cutting out the blade from the sheet.

2. Toothing with a press and appropriately formed dies.

3. Hardening by plunging while heated in an oil bath. In this state the metal is extremely brittle.

4. Tempering and straightening; the latter is effected by hammering on an anvil or by compressing several blades, while hot, between two dies worked by a hydraulic press.

5. Grinding and polishing with emery-powder.

6. Filing and setting the teeth.

7. Reheating to restore the elasticity lost in tempering.

8. Removing the scale by immersion, first in dilute acid, and afterwards in alkali to remove the acid.

9. The handle is attached and the blade tested.

Brad Awl.

The simplest form of boring tool is the awl. It consists of a piece of small steel rod, with one end fastened in a wooden handle, and the other doubly beveled to a sharp edge. The use of the awl is to prepare holes for the admission of nails and screws.

Its greatest drawback is the ease with which the awl may be broken. When holes are to be bored with the brad-awl, the edge should be placed across the grain of the wood.

Hammer.

A tool for driving nails, beating metal and the like.

The hammer selected for the desk top is known as a riveting hammer. It is used by both metal and wood workers for light work.

Tools of metal, of which the hammer was among the first, must have been in use for many centuries. Tubal Cain, the descendant in the sixth generation

from Cain, was an "artificer in brass and iron"; copper, probably, rather than brass. Brass and bronze are not distinguished from each other by name, either in Greek or Latin.

The first form was perhaps a stone fastened to a handle, many such are found in the relics of the stone age, before man had learned the use of metal.

In the Bible we read of hammers for nails, forging, and for breaking stone.

Modern hammers are of many shapes and kinds. The parts are the *handle* and *head*. The latter has an eye, face, peen, or claw.

Nail Set.

The nail-set, or punch as it is sometimes called, is simply a piece of tapering steel, used with the hammer to drive the heads of nails below the surface of the wood they are in. To avoid slipping, the point is made hollow. Nail-sets with hollow points are the best. Several sizes are made to suit the various nails.

Chisel.

An edged tool for cutting wood. It is operated by striking its upper end with a mallet or by pressure. Mr. Burton, an Englishman, found at Thebes, and deposited in the British Museum, a carpenter's basket and a kit of tools which have survived their owner some thirty centuries.

Chisels of early Egypt were of bronze, the handles of tamarisk. In some cases the blades were attached by thongs to the handles.

The knife must be regarded as the primary tool, and the chisel as a strong knife sharpened and presented endwise.

The chisels and gouges of the Tahitians when first discovered were of bone, generally that of a man's arm between the wrist and elbow. The bone tools disappeared in a few years after the advent of the white man.

The chisel used in this course is 3/8 inch wide and known as a *tang firmer* chisel and should be used only for fine work. The handle is made of applewood.

Carpenters use other, and heavier chisels, one kind is known as the *socket firmer*, and the other as a *mortise* chisel. The socket-firmer is employed in all kinds of carpenter work.

The mortise chisel is made much heavier than the socket firmer, and is used in connection with the mallet for making mortises.

Marking Gauge.

The gauge is a tool for marking on the work lines parallel to the edge. The gauge consists of two pieces of wood, the stem or beam and the stock or head with a thumb-screw in the latter, which when tightened, holds the head firmly in any desired posi-

tion on the beam. The spur is a piece of steel wire fitted in the beam, the cutting or marking end being filed to a wedge, the side farthest from the head should be straight, and as nearly as possible parallel to the side of the head. The inner side of the spur should be slightly rounded. When both sides of the spur are filed straight across or parallel to side of the head, the tendency of the gauge is to run off or make poor lines.

With a properly filed and adjusted spur the gauge should act easily and make clean lines. The spur should only project sufficiently to produce a line clear enough to work by, otherwise it will not be suitable for accurate work.

Pliers.

A small pair of pinchers with jaws flat on the inner side (called flat jawed pliers), which are "file cut" to enable them to take fast hold of small pieces of metal to be filed, bent, etc.

The knife-like edges on one side are intended for cutting wire, or a narrow strip of thin metal.

Pliers with peculiarly shaped or proportioned jaws are called *round-nosed* pliers, *long-nosed* pliers, *cutting* pliers, etc.

Gimlet.

The gimlet of the Greeks had the cross-head or handle of the style now in common use. The earliest specimens found, are of the hollow pod style, with-

out the screw point, and it demanded a large expenditure of muscle. In course of time the screw point was added.

The twisted or spiral form of gimlet is an American invention.

The screw point serves to give a hold at first, and gradually to draw the tool deeper into the work. In boring holes with the gimlet near the edge or in thin wood, it is best to use very little pressure, and to give a quick movement to the handle. "Crowding" the gimlet is very likely to split the work.

Clamp.

A device for temporarily holding the parts of a piece of work while being operated upon. Also for holding glued joints while the glue is hardening. The style of clamp used in desk top outfit is made of malleable iron and is quite strong.

Sandpaper.

This is a stout paper coated with hot glue and then sprinkled with sharp sand of different degrees of fineness. The different grades are designated as 000, 00, 0, ½, 1, 1½, 2, 2½, and 3. The latter number is very coarse.

Glasspaper is fine kind of sandpaper made of powdered glass.

NOTES ON WOODS USED IN DESK TOP COURSE.

White Pine.

This is the most useful and indispensable tree of the American forests, affording a timber of greatest value for many uses, as for finishing, interior work, doors, sash, blinds, clapboards, shingles, and is used in pattern making because of the comparatively small degree to which it shrinks and swells owing to changes in the atmosphere.

It is found from Newfoundland to the Winnipeg River, southward through the northern states and along the Allegheny Mountains to Georgia. Its finest growth is in the region of the great lakes.

The wood is soft, light, compact, and easily worked. It contains very little resin.

The tall, straight trunks of the pine extend upwards perhaps a hundred feet to a limb, thence skyward, with a crown of dark evergreen foliage, graceful and majestic.

Basswood (Lime, Linden).

Basswood is found throughout a wide range of the United States and Europe, and has many varieties. In some localities it is called *linden*, and *lime-tree*. It grows to a magnificent size, bearing smooth, heart-shaped leaves, and having fragrant flowers

which are favorites with the bees. The foliage is dense, and in Europe it is used very extensively for ornamental planting.

In Russia the inner bark of the basswood is made into textile fabrics, cordage, and the like.

The wood is yellowish-white, soft and light, but moderately close-grained and tough. It is used in cabinet work and for the panels of carriages.

Tulip Tree (Poplar, White Wood).

This wood is quite variable in weight, usually light, soft, stiff, but not strong, of fine texture and yellowish color; the wood shrinks considerably, but seasons without much injury, works and stands well. In some localities it is used for siding, for panelling and finishing lumber in house, car and ship building, for side-boards and panels of wagons and carriages; also in the manufacture of furniture, implements, and machinery, for pump-logs, and almost every kind of common wooden ware, boxes, drawers, etc. An ideal wood for the carver and toyman. It grows to a large size, and is found from New England to Missouri and southward to Florida.

The cucumber tree resembles and is often confounded with tulip wood in the markets.

The Ash.

The ash is a rapid grower, and is found in almost all our broad-leaved forests. The wood is heavy, hard,

strong, stiff, quite tough, not durable in contact with soil, straight-grained, rough on the split surface, and coarse in texture. Takes a good finish.

In carpentry ash is used for finishing lumber, used in shipbuilding, in the construction of cars, wagons, carriages, etc.; in the manufacture of farm implements, machinery and furniture of all kinds, and also for barrels, baskets, oars, and ball-bats.

The wood of second-growth white ash has, perhaps, no equal for lightness, elasticity and strength.

The black ash grows chiefly in swamps throughout the eastern, northern, and north-western states. The wood is not so valuable as that of the white ash.

Cherry.

The lumber furnishing cherry of this country, wild black cherry, is a medium sized tree scattered through many of the broad-leaved woods of the western slope of the Alleghenies, and is also found from Michigan to Florida and west to Texas.

In a rich soil it grows rapidly and forms one of the most valued of our native woods. It almost equals mahogany, which it in some degree resembles when darkened by age.

It is chiefly used for finishing lumber for buildings, cars, and boats, also for furniture.

The wood is heavy, hard, strong, of fine texture, color reddish brown. It works and stands well, takes a good polish, and is much esteemed for its beauty.

Black Walnut.

Walnut wood is heavy, hard, strong, of coarse texture; the sapwood is whitish, the heartwood chocolate-brown. It works and stands well, takes a good polish, is quite handsome, and has been for a long time the favorite cabinet-wood in this country. Walnut, formerly used even for fencing and railroad ties, has become scarce and too costly for ordinary purposes, and is to-day used largely as a veneer, for inside finish and cabinet work; also in turnery, for gunstocks, etc. Black walnut is a large tree, with stout trunk, of rapid growth, and was formerly quite abundant throughout the Allegheny region, occurring from New England to Texas and from Michigan to Florida.

Maple.

Wood heavy, strong, stiff, and tough, of fine texture, frequently wavy-grained, this giving rise to "curly" and "blister" figure; not durable in the ground or otherwise exposed. Maple is creamy white, with shades of brown in the heart, wears smoothly and takes a fine polish. The wood is used for ceiling, flooring, pannelling, and other finishing-lumber in house, ship, and car construction; it is used for the keels of boats and ships, in the manufacture of implements and machinery, and for furniture. Maple is also used for shoe lasts and other form-blocks, for shoe-pegs, for piano actions, school apparatus, for wood type in show-bill printing, tool

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handles, in wood carving and turnery. The maples are medium-sized trees and of fairly rapid growth.

The sugar-maple is sometimes called hard-maple and rock-maple. The silver maple is often called soft-maple. The wood of this tree is lighter, softer and inferior to hard-maple.

HISTORY OF WOOD SCREWS.

According to "Tomlinson's Cyclopedia" volume IV, 1852, "the blanks for (wood) screws were formerly forged by the nail makers, they being nearly the same as the countersunk clout nails, except that the ends are not pointed. The blanks were next made out of round rolled iron cut to the required lengths, the heads being formed by pinching them while red-hot between a pair of dies, and the threads were cut by means of a file."

The screws referred to in the foregoing were doubtless blunt-pointed, but gimlet-pointed screws were undoubtedly made as early as 1755.

"Gimlet-Pointed Wood Screws.—Mechanics of adult age can easily remember when gimlet-pointed screws came into use, within the last thirty years, superseding the blunt pointed ones before used, and the former have been considered a modern invention. But we have seen this morning a half dozen screws with excellent gimlet points which were taken

from an old piano and bear unmistakable evidences of age and of having been made before screws were made by machinery. The piano is inscribed 'Jacobus Kirckman, Fecit, Londini, 1755' and the screws are doubtless of that date. The most curious point in the case is that after such screws as these had once been made mechanics should have gone on using square pointed screws for nearly a century.—(*Worcester Gazette.*)"

BLUNT POINTED SCREW.

The earliest known public exhibit of gimlet-pointed wood screws in this country was that on a sample card of wood screws made by Japy Freres, Beaucourt, France, imported by Messrs. Fish, Grinnell & Co., for the late Jonathan Congdon, Esq., hardware merchant, of Providence, R. I. These screws may have been produced in France upon American machinery, which was sent in 1835 from Poughkeepsie, N. Y., to Japy Freres.

GIMLET-POINTED SCREW.

In United States patent No. 154, of March 30, 1837, granted Sloat (of Ramapo, New York), and Springsteen (of Poughkeepsie, New York), for a

wood screw threading machine, are the following words: "So that the screw may be made a gradual taper or all the way of a size, or give it an acute taper at the point, making what we call 'gimlet points' or any other shape desired."

It may, therefore, be conclusively stated that gimlet-pointed screws are extremely old, and that the inventor of them has never as yet been named, although many special forms of gimlet points for screws have been invented and patented in the United States and elsewhere during the past sixty years.

NAILS.

In the beginning of the nineteenth century nails were ordinarily manufactured by hand forging, usually by women and children.

Nail machinery originated and developed chiefly in the United States. This was a natural result of the universal use of wood for buildings.

In the old hand-working days some of the nail-makers became, through constant practice, very expert at the trade. It is on record that a workman in Smethwick, England, made in two weeks 40800 nails. To accomplish this wonderful feat he had to heat his nail iron 42836 times, to weld together large numbers of short bits of iron and to strike each nail 25 blows.

Steel wire nails which have taken the place of cut nails are a French invention. They have great holding power, though they are light and smooth.

The old English term "penny," as applied to nails, is understood to mean a certain number of pounds to the thousand nails, as, for example, "six penny" means 6 pounds to the thousand nails; "ten penny" means 10 pounds to the thousand nails. The term "penny" when used to mark the size of nails is supposed to be a corruption of the word "pound."

NUMBER OF WIRE FINISHING NAILS PER POUND.

Wire G'ge	3-16	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1½	1¾	2	2¼	2½	2¾	3	3½	4	4½	5	6	7	8	9	10	11	12
⅜	.....	.....	.....	.....	.....	.....	.....	.....	.....	33	27	23	20	18	16	15	14	12	10	9	8	7	6	5	4½	4	3½	3¼
0	.....	.....	.....	.....	.....	.....	.....	.....	.....	34	29	25	21	19	17	16	15	13	11	10	9	8	7	5½	5	4½	4	3½
5-16	.....	.....	.....	.....	.....	.....	.....	57	50	45	38	32	28	25	23	21	19	16	14	13	11	10	8	7	6	5½	5	4½
2	.....	.....	.....	.....	.....	.....	.....	65	58	52	44	37	32	29	26	24	22	19	16	14	13	11	9	8	7	6½	6	5½
3	.....	.....	.....	.....	.....	100	87	76	67	60	50	43	38	34	30	28	25	22	19	17	15	13	11	10	8	7½	.....	.....
4	.....	.....	.....	.....	.....	120	103	90	80	72	60	51	45	40	36	33	30	26	23	20	18	15	13	11	10	9	.....	.....
5	.....	.....	.....	211	169	141	121	106	94	85	71	60	53	47	42	39	35	30	26	24	21	18	15	.....	.....	.....	.....	.....
6	.....	.....	.....	247	197	164	141	123	111	99	82	71	62	55	50	45	41	35	31	28	25	21	18	.....	.....	.....	.....	.....
7	.....	.....	.....	290	239	200	171	149	133	120	100	85	75	67	60	54	50	43	37	33	30	25	.....	.....	.....	.....	.....	.....
8	.....	.....	.....	345	275	229	197	172	153	137	115	98	86	76	69	62	57	49	43	39	35	29	.....	.....	.....	.....	.....	.....
9	.....	.....	.....	414	331	276	236	207	184	165	138	118	103	92	82	75	69	59	52	46	41	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	663	496	397	333	283	248	220	198	165	142	124	110	99	90	83	71	62	55	50	.....	.....	.....	.....	.....	.....	.....
11	.....	.....	837	628	502	418	359	314	279	251	209	179	157	139	125	114	105	90	79	70	.....	.....	.....	.....	.....	.....	.....	.....
12	.....	.....	1096	822	658	548	469	411	365	329	274	235	204	182	164	149	137	117	103	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	.....	.....	1429	1072	857	714	613	536	476	429	357	306	268	238	214	195	178	153	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	.....	2840	1893	1420	1136	947	811	710	631	568	473	406	350	315	284	258	236	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	.....	3504	2336	1752	1402	1168	1001	876	778	701	584	500	438	389	350	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	.....	4571	3048	2280	1828	1523	1305	1143	1015	913	761	653	571	508	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	.....	6233	4156	3116	2495	2077	1781	1558	1385	1246	1038	890	779	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	8276	5517	4138	3310	2758	2364	2069	1839	1655	1379	1182	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	.....	10668	7112	5334	4267	3556	2933	2667	2370	2133	1778	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	20000	15000	10000	7500	6000	5000	4400	3750	3333	3000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
21	23702	17777	11850	8888	7111	5926	5079	4444	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	30476	22856	15237	11428	9143	7618	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

These approximate numbers are an AVERAGE only, and the figures given may be varied either way, by changes in the dimensions of the heads or points. No-head nails will run more to the pound than table shows, and large or thick headed nails will run less.

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